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## Doing things and how to do it

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### Doing things and how to do it

This was prepared after attending a day at a conference, “Doing things with things,” which was held as part of the preparation for an edited book with papers from the various speakers...

Attending only one day makes it difficult to say whether or not some themes have been attended to at the conference or not. It seemed to me, however, that what lacked was an understanding of the very activity of actually doing something with something. One discussion revolved around the intended use and the non-intended use, and I will try to look into this issue later in these notes. Vermaas and Houkes who tried to revive the concept of plans in use raised another discussion. As I remember it, they focused on plans as deliberations on how artefacts can be used to achieve something. And they claimed that “use” is ambiguously accounted for in Gibson. What they wanted was a shift in focus from function to plans. This spurred my thoughts on what artefacts are and how they become a part of our activity and this first part of the notes is a search for an answer to the second part, whereas the second part of the notes is a search for the first as this is connected with intended and non-intended use.

So first I try to see what kind of activities is available to the human agent, and through example, drawings and discussion to connect it with the distinction between operation, action and agency.

This paper is dedicated mainly to the analysis of different levels of tool use. There is a tentative search for the different levels of affordances as activity, but I am not sure this is fully developed. In an article by Leeuwen, Smitsman & Leeuween (1994) the development of tool use in early childhood from an affordance perspective is more fully examined:

“The study of tool use focuses attention on situations in which the organism realizes its needs not immediately but by using environmental resources as means to an end. In this sense, tool use represents mediated action.” (op.cit., p.174)

I will later argue that we should be wary about the term “mediate” as its connotation is closely connected with that of “indirect,” and that we easily slip into the trap of classical representational thinking. Michotte (1951/1991) asked himself this question: “Is the perception of the tool function direct?” (p.88) From trying to answer this through experiments he made a concept of “tool effect”:

“the intervention of the intermediary appears to be purely passive and dependent on the action of the motor object with which it is integrated as a constituent part; it is this which gives it a characteristic phenomenal aspect.” (op.cit. p.97-98). By varying the speed of the objects Michotte found that the objects were no longer perceived as passive but as self-acting. It should be noted that what interested Michotte was the perceiving of two objects independent of the perceiver’s own activity. That is, in the different motions of two objects meeting each other there is information about whether it is a tool affecting something or another kind of causal impression. What is important here is that there is information in the motion of a tool that makes it possible for us to distinguish it as a specific tool. Furthermore, Michotte suggested that this information is actually the primary source of the concept of tools.

“It seems logical to suppose that the primary source of this concept [tool or instrument] ought to be found in the tool effect in its strict sense, rather than in those complex cases where the instrumental function is attributed to an object on the basis of simple temporal relations despite the existence of a kinematic discontinuity.” (op.cit., p.102).

“Finally, would it be too outrageous to suppose that the tool effect also marks the starting point for the intentional use of tools at the very dawn of humanity?” (ibid.)

So Michotte thinks that the *fact* that there is a directly perceivable relation between two objects specifiable as a tool relation (the tool effect) leads to the concept of tools and intentional use of tools. It is not just or primarily the functional development of the tool as an extension of bodily skills, but this causal relation between things.

For Leeuwen et al (1994) this and the concept of affordance lead to the below figure:

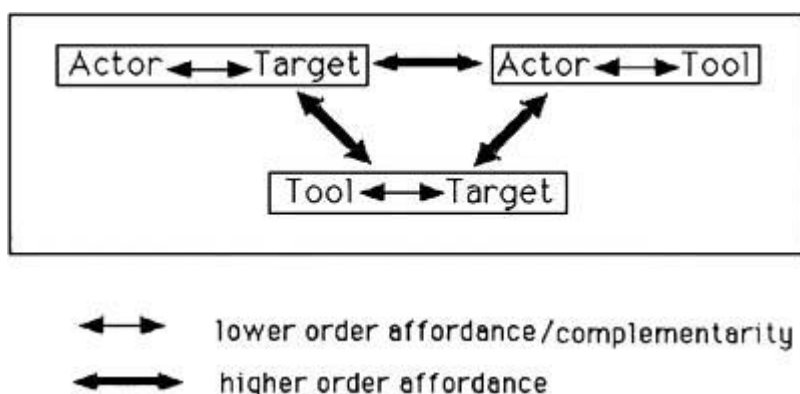


Figure from Leeuwen et al (1994): the text is: “Relationships among actor, tool, and target as mutually constraining complementarities in a second-order affordance structure” (p.176)

Leeuwen et al (1994) concludes that: “In becoming a tool, an object must be handled by an actor in relation to other objects or substances. Therefore, tool use was defined as performing an action on a target by performing an action on a tool. The action on the tool is embedded in the action on the target.” (p.188-189).

This is implicitly the same definition that I have come to use in the below analysis. For academic reasons it should be noted, however, that this might be too loose a use of this concept, as it is not just the immediate use that constitute a tool but also the production history, the social linguistic embeddedness and the common praxis (or canonical use) that the tool rests in, which is of importance. Tool use, defined only as use, will make difficult the differences between the tool use of certain animal species and human beings. I am not saying that other animals do not use objects as tools, but rather that these objects are not tools in the sense that they have been produced for a purpose, are conceptualised as specific kinds of tools, and have canonical uses in a social praxis. For now, however, this needs not concern us.

## A) Doing things

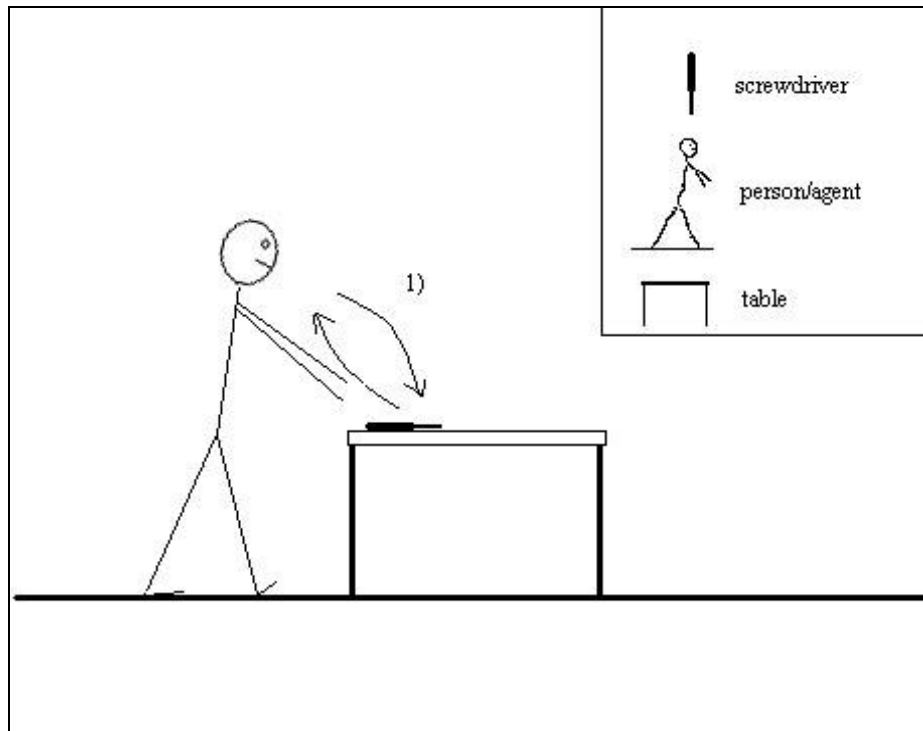


Figure 1: A) Doing things.

This first figure illustrates the operation where the tool, in this case, a screwdriver, is picked up by finding it in the room, walking towards it, picking it up, and holding it. As such, the tool is not used but only found, and therefore it is only ‘doing things’ in the sense of ‘doing something’. There is no distinct difference between this kind of activity and other kind of activity directed towards non-artefacts, like finding an apple and picking it up, or finding a stick.

The no. 1) in the figure is signifying the activity that the agent does, what the object *affords*. In this example it could be “reachable”, “pick-up-able”, and “wield-able”, all three being relational concepts as it implies an object that can be reached by an agent with the ability to walk towards and reach out for the object, and an object, of a certain size fitting the agent’s hand(-s) and within a lift-able weight range depending on the strength of the agent. The object is affording these kinds of activity only when the object and the agent have a certain ‘fit’. The object and the agent are also constraining the possible affordances, as there are things the agent cannot do with the object, both qua the physical properties of the object, and qua the physical properties of the agent (and, we might add, because of the social constraints in which the agent is embedded).

If this is the only thing the agent wants, finding and picking up the screwdriver, then there is an almost complete overlap with what the object affords and the intention of the agent, the *goal-directed activity*. The goal of picking up the screwdriver consists of the *operation* of reaching it and picking it up. For the design of the artefact, i.e. the screwdriver, to fulfil the intention of the user it needs to be designed with respect to these operations. The research by Whyte et al. (1994) on infants has shown, however, that the intention of reaching for something not only depends on the object but also depends on the nature of the task. They found:

"...a clear trend for grip configuration to vary as a function of action within the same object geometry. Thus, the influence of object size on the affordance of differential actions was consistent across the two experiments...*These findings are consistent with the notion that action is an emergent property of the interaction of three sources of constraint - namely, the environment, the organism, and the task.*" (p.217, italics added)

That is, how the operation is *nested* in an overall task of doing something determines how we actually perform the specific operation. So the first figure is way too simple to be of any use in the every day world.

## B) Doing something with a thing

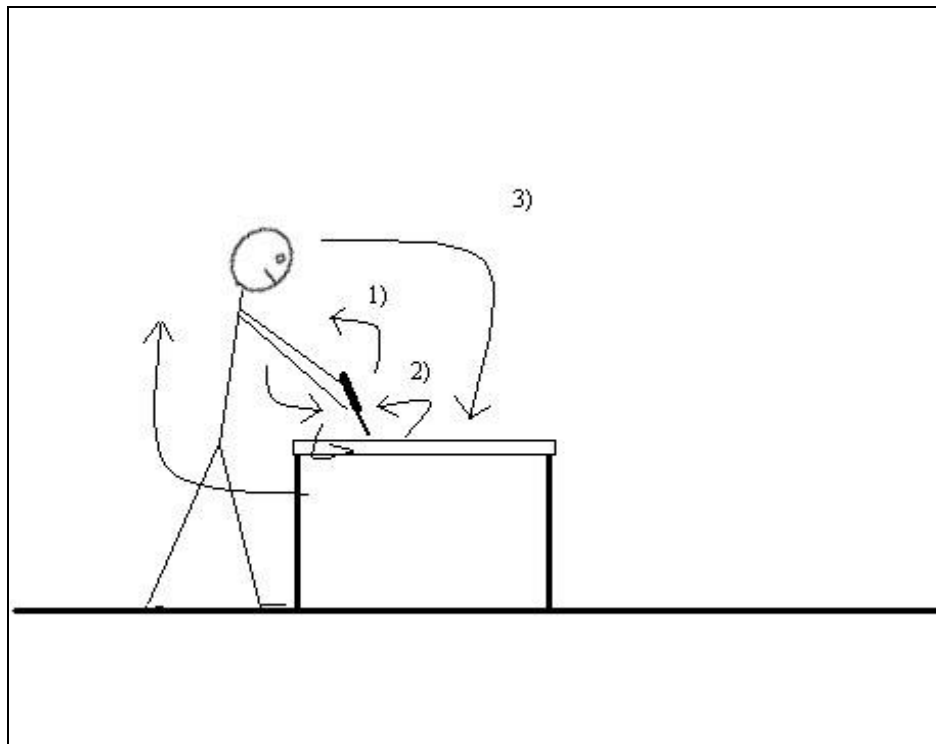


Figure 2: B) Doing things with things.

The second figure advances the first figure a bit. Here we have 1) where the agent has found and picked up the screwdriver and is now holding it, and 2) the agent starts doing something with it on the table. The agent is actually ‘doing something with the thing’. Lets say he is scratching on the surface of the table with the screwdriver, then the activity the agent is performing consists of two different activities, first, holding the screwdriver by its handle in his hands, and second, scratching the surface with the tip of the screwdriver. What Gibson (e.g. 1979, p.40-41) and Activity Theory have noticed is that, in doing this kind of activity, the first kind of activity seemed to disappear from the attentional awareness. If something is wrong with the handle, the attention immediately shifts from the tip to the handle. But given that the handle stays where it is supposed to be, we just happily scratch the surface on the table. Gestalt psychology would say that there is an attentional ‘figure-ground’ relation here, the tip is the ‘figure’, and the rest, including the handle, is the ‘ground’ or in the background.

Steenbergen et al, 1997, *Eco. Psych.* 9(2): tool use as attached to the body to extend the capacity for action. See p.115, it is not enough to focus on the implementation of an object for it to become a

tool, it is also necessary to focus on the “activity of tool use itself rather than internal cognitive mechanisms”

The no. 3) signifies this attentional awareness and is the direction of the agent’s attention as well as his *intention*. He intends to scratch the surface with the screwdriver in his hands, and so his goal directed activity is towards the surface of the table and its “scratch-ability”. So we now have two levels of affordances that are purely relational, and cannot be understood without understanding the agent, the table, and the tool. The tool is “hold-able” or “wield-able” at the handle, and the table is “scratch-able” only with the tip of the screwdriver (we might try scratching with our nails but not to much avail). So the affordance “scratch-able” implies the hardened metal tip on a tool like the screwdriver, and the affordance “hold-able” implies the above-specified relation between hands and tool. But given that the agent holds the screwdriver in his hands, he picks up the information about the table as affording “scratch-able” if he is inclined to do some scratching, depending, obviously, on the surface material of the table and the tool in hand.

The agent intends to scratch the surface of the table and so this is what he has planned for. He might *know* what the table is made of; he might *know* which tool is best for the job; and he might *know* the best way of doing some serious scratching. All this *knowledge* might not be explicit knowledge but could just as well be implicit, or *tacit*, knowledge (e.g. Polanyi, 1962). What is important is that the agent wants to scratch the table, so he picks up the appropriate (!) tool and goes to work. All this does not have to be in close vicinity, temporal nor spatial, as there in the *task* is the necessary information for the *experienced* “scratcher” to do a decent job. The inexperienced “scratcher” will, however, need to have the things somewhat closer at hand, for example, a variety of tools used on various tables. Mammen (199X?) showed how we can disregard the tool *when* we have used it to examine the invariant relation between two objects. That is, the tool does not affect the substance-relation, but are used to discover the relation between objects. A diamond does not become harder than a stone just because we scratch it with a screwdriver. If we use a screwdriver to explore both the stone and the diamond we will be able to discover a relation (diamond harder than stone) that is *independent* of the tool that we uses (screwdriver, pen or sword it makes no difference). An experienced “scratcher” has made a lot of these explorations and will know that oak is harder than pine and therefore needs either more force applied or another, sharper tool to scratch it. It seems that this was the relation that Michotte found was directly perceivable.



### C) Doing something with things with things

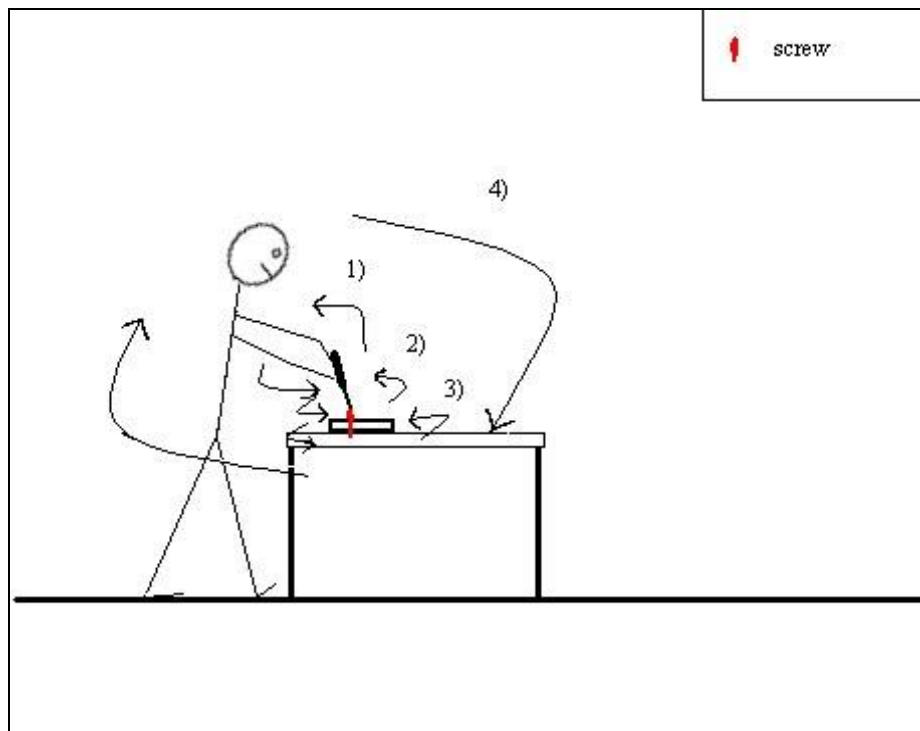


Figure 3: C) Doing things with things with things.

The third figure is an even further complication of the activity. The no. 1) is still the screwdriver being held in the hand of the agent but now no. 2) is the tip of the screwdriver resting on the head of a screw. No. 3), then, is the screw being screwed into the table through a piece of wood. For the agent skilled in the art of using a screwdriver the attention is on the unseen, but felt, presence of the tip of the screw being driven into the table and neither on the grip of the screwdriver nor on the tip of the screwdriver resting on the head of the screw. What is of interest for the agent is whether the table is of a substance that is “screw-into-able” and how much force should be applied to do so. So no. 4) is the direction of the goal, in as much as the agent *wants* to screw a screw into the table through a piece of wood. The fulfilling of this goal now consists of finding and holding the screwdriver and the screw, positioning the screwdriver on the head of the screw, and screwing the screw into the table.

This example is, of course, a simplified version of the complexity of our daily activity. I think that at least a fourth type of doing things within this illustration can be identified but this is not relevant

right now. These three types seem, however, to be the most common in our daily messing around with the things in our surroundings so let me summarize these:

Doing things: A is where the goal and the main operation coincide. We pick something up just to hold it, lift it, or carry it.

Doing things with things: B is where the goal is something that the thing can *do* for us (the thing as an actor? The relation between the agent and the thing as an actant (a la Latour)?). We lift the cup and drink the liquid contained by it; we write with the pen; and we switch the light on or off.

Doing things with things with things: C is where the goal is not the thing we hold in our hand but something we use the thing we hold in our hands (for example) for to do something to another thing which might affect yet another thing. These three types are the most abstracted unit of analysis for something to remain meaningful.

Let us consider the process of making coffee (in some elaborate detail, I am sorry to say): There are a couple of things that need to be in order before I can brew my coffee. I need to get water and cook it, as I make filter coffee, and I need to prepare my filter and coffee can, so I can pour the hot water over the beans and into the can. I might also need to crush the coffee beans first if the coffee company have not done this. This very abbreviated process typically takes about 5-10 minutes all in all, though the agent (i.e., me) does not have to be solely occupied by making coffee in this span of time. I have tried to illustrate this in the below figure:

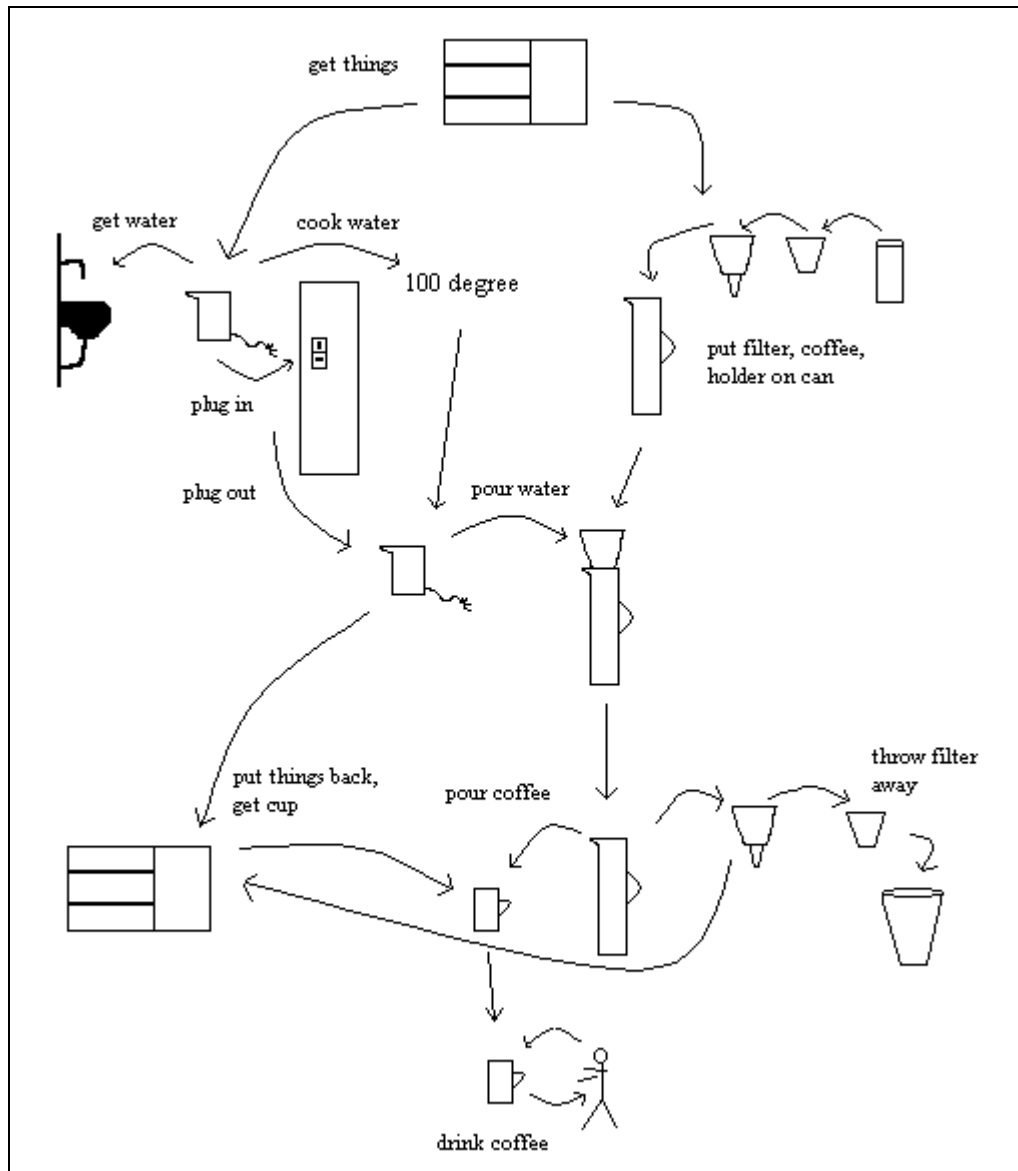


Figure 4: the coffee making process

Please note that the agent is not illustrated before the actual drinking of the coffee, which signifies the end of this overall event. This is not because the agent is not present during the coffee-making but because the intention with the activity is to make drink-able coffee and drink it. There is a kind of hierarchy in the order of making coffee even though some of the things are interchangeable. I have to cook the water before pouring it over the beans, but I need to get water first, and I also have to get a boiler before getting the water. Before I pour the cooked water I need to prepare the coffee can and the filter, and after making the coffee I might want to put all the things back to their appropriate place, so as not to make too much of a mess.

All the elements of this kind of coffee making requires an agent who can lift, hold, wield, place, put and so on, in short, do something. But the interesting thing is not just on this level but also the way the agent does something with various particular things. Or in other words, it would be impossible to decompose the coffee making into the “direct” (? [direct meaning what I bodily “relates” to, A]) operational aspect of the process.

The next level is what the agent does with the things. Here, I cook water; place filter and holder together and pour beans into the filter; pour water over the beans; remove the holder and dispose of the filter; put the things back; screw the lid back on the can; and pour the fresh coffee into the cup, which I have previously taken out of the cabinet. These things also have a “direct” operational aspect, but the interesting thing is not me holding them, but what the things *do* when I do something with them, like holding the boiler and inclining it into a certain degree of inclination while positioning it over the coffee can and its filter holder containing coffee beans resulting in the water pouring over the beans. In the theory of Vygotsky the tools *mediate* certain human activities, but this does not mean that activity are in-direct in the sense that it is less immediately perceivable as an activity than non-tool activity. Rather, it is another kind of “directness,” not as indirect but rather as *inter-direct*. By inter-direct I mean that it signifies the relational aspect between two objects and the agent; there is a “direct,” or lawful, relation between the agent and the object in hand as well as a “direct,” or lawful, relation between the object at hand and the object manipulated by this in-hand-object (see also Leeuwen et al, 1994). When we pick up a screwdriver it becomes part of us, it is lift-able and grasp-able, and its functionality becomes part of our capacity. *We* are screwing out the screws *using* a screwdriver. There is a inter-dependent and mutual connection between these two types of relations, the one between us and the screwdriver, and the other between the screwdriver and the screw. And this connection is, in lack of a better word, inter-direct, and not in-direct.

The third level is what I do with the things through other things. I pour water into the can over the beans and what comes into the can is therefore coffee. No mysterious process is involved, except for the un-initiated into the art of coffee making, but what I hear when I hear the *water* drizzle into the can is *coffee* filling up the coffee can. I need to be aware of two things at the same time, one is that I do not pour too much water into the filter holder and the other is that I do not pour too much coffee into the can. I suggest that awareness of the first kind is “doing things with things”, or B for short as illustrated in figure 2, and the second kind is what I termed above as “doing things with things with things”, or C as illustrated in figure 3. This relation is also inter-direct; I do not need to *infer* that coffee is being made, when I pour boiled water over the correctly prepared arrangement.

What I need, though, is to *learn* this relation, sometime painstakingly, and this process might include inferential or indirect aspect, though it often rests on practical experience with the tool that is to be learned.

These three levels are the operational aspect of making coffee, and I need to focus my attention on the various levels at various times. Sometimes I need to consider whether I am able to do something or not with a thing, at other times (mostly?) I am focused on making the things do what I would like them to do, and again at other times I need to be aware of something that the things do to each other through my operations with them. The “direct” and “inter-direct” character of awareness does not exclude, as I have indicated above, that other kinds of awareness can be necessary or in play. What it means is that most of our activity with familiar things are based on the “direct” and “inter-direct” awareness of our surroundings, not on symbolic mediational awareness or inferential processes.

This, however, is only one kind of parsing of the events that we are enmeshed in every day. What I want when I am focusing on any of the three levels is still the making of coffee. All these doing-things-things are nested within my overall activity, which is to make the coffee in order to drink it. What rules my behaviour is the wish or need for coffee, and the resulting coffee, which still only ‘exists’ as components, therefore motivates my activity; it is *why* I make coffee, because I want coffee. *What* I do during the process is directing my attention towards the three various levels mentioned above (A, B, C), a directing being necessitated by the very activity with the things. *How* I do it is prescribed by what I want to do and constrained by the conditions in my surroundings.

I have tried to draw this out in the below figure:

Event clusters	Object centered	Event acts	Operational affordances (A)	Functional relations between things (B)	Things-mediated relations (C)
Preparation	boiler	get boiler pour water into boiler plug boiler in	grasp-able bear-able wield-able walk-with-able	pour-into-able (contain-able) plug-into-able	
	coffee-can	get can, filter, coffee, holder  put together on can	grasp-able bear-able wield-able	put-into-able  fit-together-able	
	cup	get cup	ditto		
Execution	boiler	turn on boiler cook water	switch-able	heat-water-able	water-coffee
	coffee-can	pour water through holder, filter, beans into can  remove holder  put lid on can	grasp-able bear-able wield-able	pour-into-able  fit-together-able	
Cleaning up	boiler	plug out boiler put boiler back	remove-able grasp-able bear-able wield-able		
	coffee-can	put holder back throw away filter	grasp-able bear-able wield-able		
Goal/ action	cup	drink coffee	grasp-able wield-able drink-able	pour-into-able	

Figure 5: a different parsing of the coffee-making process (I am uncertain about the terminology in the above figure, so please correct me if you have better wordings [NB: “coffee” under object centred in Goal/action is of course necessary for drinking coffee, not just a cup])

Another fact is that some of the things we do when we make coffee are very dependent of the serial order and some are not. For example, I need to get a boiler, pour water and plug the boiler into the electrical system before I can cook the water. I do not need to prepare the filter, coffee beans, and holder before the water has been boiled, but I am free to do it if I like. I cannot pour the boiled water without this preparation, though. (I have experienced to mess up the order by forgetting to put beans in the filter, forgetting to boil the water before pouring, forgetting to put the filter before the beans, and every one of these mistakes (made in a distracted moment) did not make any coffee out of the activity.) I do not need to get a cup before I want to pour coffee into it, and I don't need to clean up before drinking my coffee, so the clean-up event cluster can be postponed to later. However, it makes no sense to clean up before I am finished with pouring the boiled water into the coffee can.

There is some variability but not a whole lot of it. If I want to be an *efficient* or *rational* coffee-maker there might be an *optimal* process in all this.

How can this help us to; 1) design “intuitive” interfaces in programmable technologies, and 2) evaluate the designs (whether in advance of production or in retrospect)? First we need to be clear that there is *in principle* no difference between the use of things and the use of a programmable interface within this way of parsing it. Using an “actual” object to procure some thing with or programming a VCR using a remote control are different as a matter of quantity and not quality, so to speak. They both necessitate operations, they both have nested events within larger events, and they both have relations that you manipulate by manipulating other relations. The difference, as I see it, lies in *how* the levels utilises different capacities, are robust to serial variations of sub-events, makes necessary information available, guides behaviour, and not in *if*.

... Analysis needed on programmable technology within this terminology...

-see Karat, J., Karat, C-M-, & Ukelson, J. (2000): Affordances, Motivation, and the Design of User Interfaces: *Communications of the ACM*, V. 43(8), pp.49-51.

-St. Amant, R. (1999): User Interface Affordances in a Planning Representation: *Human-Computer Interaction*, v. 14(3B), pp.317-355.

I have tried to show a way of understanding the process of doing something in a world of things, and using the things either in themselves or in connection with other things. The three levels mentioned above are by no means a complete picture of the possibilities in the environment, but might describe the character of some of the more typical activities with things.



### The user uses an object:

What is an artefact and how is it used, intended and non-intended.

User:				Uses:				Object:			
Physical properties								Physical properties			
Body metric				Affordance as activity Use as activity				Environmental metric			
Normal		Non-normal		Intended		Non-intended		Designed planned 'artefact'		or →	Non-designed → 'natural'
Bad	Good	Bad	Good	Bad	Good			Bad	Good		

There seems to be two senses of bad—good that is applicable in respect to the *user*. The first of the two senses is bad as *poor* contrasted with good as *excellent*. Now we have an agent or user who can be a poor user, one who probably suffers from some kind of technological helplessness (a la Seligman's concept of learned helplessness in depression). This user does not understand the objects use, and, hence, cannot use it, neither as it is intended or otherwise. Then there is the excellent user, who *qua* his/her proficiency, or just a 'natural knack' for things, always does the 'right' thing, and knows how to operate something in accordance with its intended use.

The second of the two senses is bad as *different* [odd?] contrasted with good as *compliant*. The different [odd?] user will typically use an artefact as it pleases him/her, not bothering whether it is designed for this or that particular use. The compliant user will *only* use the artefact in accordance with its prescription (and might even be somewhat tense, when it is used for other purposes).

The two categories are not exclusive and most users would be some of both:

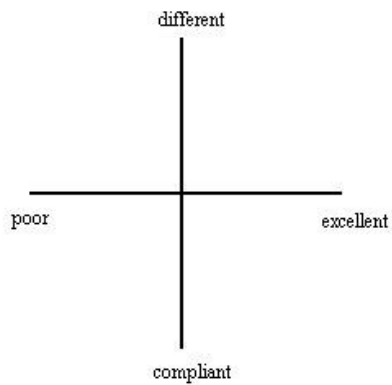


Figure 5: A tentative bad—good differentiation when it comes to the user.

When it comes to the *design* of a thing we can only apply the poor—excellent usage, because the designer will typically want some specific operation to be realizable by the product. So the ‘intention’ of the design is to provide the user with some means for realizing a goal (or maybe the artefact is also the goal, like a VCR and the viewing of videos). Even if there are standards on the area the implementation is on the poor—excellent pole, and not on the compliant—different. The implementation might differ from certain standards but it will still be evaluated on whether it is a poor (bad) or an excellent (good) design.

When it comes to the *use* of something, we might even not be able to apply good and bad to use. If we do, we would probably mean something like intended and non-intended; that is, whether the use is in accordance with the intended design (good or bad) or not in accordance with the design. On the other hand, non-intended use is not necessarily ‘bad use’ as this does not rely solely on the ‘intension’ implemented in the design but also on the situation in which it is used. A hammer might be used for a great variety of uses (bottle opener, paperweight, throwing object) without the use is the ‘intended’ use, hammering. These uses, however, are neither bad in the sense of ‘poor’ nor bad in the sense of ‘different’. They are part of the normal and social praxis with the object, the normalized or canonical uses (Costall, 1997).

Is the canonical – non-canonical pole a separate dimension in the above figure 4, or is it an area that defines use?

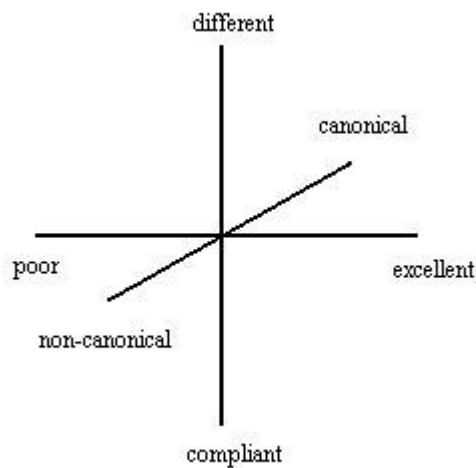


Figure 6: separate dimension

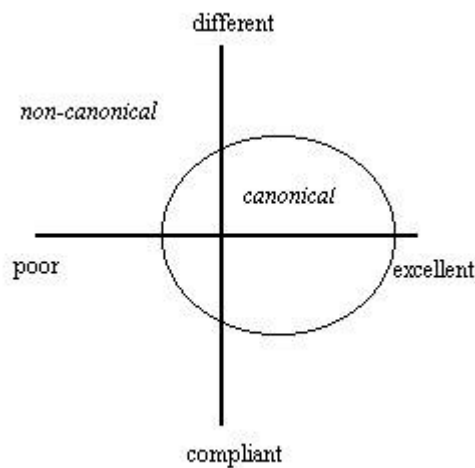


Figure 7: Area marking

Design:	-Profound design (invention)	–tends towards both intended and non-intended use, not canonical yet
	-Functional design	–tends towards intended use, canonical
	-Aesthetic design	–tends towards intended use, canonical

van Leeuwen, L., Smitsman, A., & van Leeuwen, C.(1994): Affordances, Perceptual Complexity, and the Development of Tool Use: *Journal of Experimental Psychology: Human Perception and Performance*, 20(1), pp. 174-191.

Micotte, A. (1991): The Perception of the “Tool Effect”: in G. Thines, A. Costall, & G. Butterworth: *Michotte’s Experimental Phenomenology of Perception*. Hillsdale: LEA. (orig. 1951)

Polanyi, M. (1962): *Personal Knowledge. Towards a Post-Critical Philosophy*: University of Chicago Press.

Steenbergen, B., van der Kamp, J., Smitsman, A.W. & Carson, R.G. (1997): Spoon Handling in Two- to Four-Year-Old Children. *Ecological Psychology*, 9(2), pp.113-129

Whyte, V.A., McDonald, P.V., Baillargeon, R., & Newell, K.M. (1994): Mouthing and Grasping of Objects by Young Infants. *Ecological Psychology*, 6(3), p.205-218